

Arithme-Tic-Toc

NAME _____

Complete the Mod-5 Clock Tables below for addition and multiplication. Pay special attention, looking for any patterns or relationships that exist. Below the tables, list the observations that you make, and be prepared to support your observations and discuss them with other classmates.

ADDITION TABLE					
+	0	1	2	3	4
0					
1					
2					
3					
4					

Observations:

MULTIPLICATION TABLE					
×	0	1	2	3	4
0					
1					
2					
3					
4					

Observations:

Use a Mod-12 Addition Table to answer Questions 1-3.

1. Examine the diagonals in the table. Describe any patterns that you observe.
2. What is an additive inverse? Give an example from regular arithmetic. Then give two examples from the table.
3. Below are definitions for each of the properties of real numbers. Give an example from the addition table for each property.

Identity: $a + 0 = a$ Commutative: $a + b = b + a$ Associative: $a + (b + c) = (a + b) + c$

Use a Mod-12 Multiplication Table to answer Questions 4-9.

4. In regular arithmetic, what is the multiplicative inverse of 7? How do you determine if two numbers are multiplicative inverses? Extend this idea to the table. Identify all inverses. What is different about these inverses in the tables compared to the multiplicative inverse in regular arithmetic?
5. Notice that some rows and columns contain each value 1 through 11 exactly once. Explain where and why this happens.

6. Describe any symmetry.
7. Verify that the table is commutative for all values.
8. In regular arithmetic, $6 \times 17 = 102$. Determine a process, using the distributive property of addition over multiplication, to show that $6 \times 17 = 6 \pmod{12}$.
9. Notice that the numbers in some rows are in the exact reverse order of the numbers in another row. Name the row pairs for which this happens, and explain why it happens.

- 10.** Many of the things we use each day involve modular arithmetic, such as the hours on a clock. Describe at least three other situations that use modular arithmetic.

Mod-12 Addition Table

+	0	1	2	3	4	5	6	7	8	9	10	11
0	0	1	2	3	4	5	6	7	8	9	10	11
1	1	2	3	4	5	6	7	8	9	10	11	0
2	2	3	4	5	6	7	8	9	10	11	0	1
3	3	4	5	6	7	8	9	10	11	0	1	2
4	4	5	6	7	8	9	10	11	0	1	2	3
5	5	6	7	8	9	10	11	0	1	2	3	4
6	6	7	8	9	10	11	0	1	2	3	4	5
7	7	8	9	10	11	0	1	2	3	4	5	6
8	8	9	10	11	0	1	2	3	4	5	6	7
9	9	10	11	0	1	2	3	4	5	6	7	8
10	10	11	0	1	2	3	4	5	6	7	8	9
11	11	0	1	2	3	4	5	6	7	8	9	10

Mod-12 Multiplication Table

×	0	1	2	3	4	5	6	7	8	9	10	11
0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11
2	0	2	4	6	8	10	0	2	4	6	8	10
3	0	3	6	9	0	3	6	9	0	3	6	9
4	0	4	8	0	4	8	0	4	8	0	4	8
5	0	5	10	3	8	1	6	11	4	9	2	7
6	0	6	0	6	0	6	0	6	0	6	0	6
7	0	7	2	9	4	11	6	1	8	3	10	5
8	0	8	4	0	8	4	0	8	4	0	8	4
9	0	9	6	3	0	9	6	3	0	9	6	3
10	0	10	8	6	4	2	0	10	8	6	4	2
11	0	11	10	9	8	7	6	5	4	3	2	1